Satellite Observations of Surface Fronts, Currents and Winds in the Northeast South China Sea

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Award Number: N00014-00-1-0231
http://rsag.whoi.edu/asiaex

LONG-TERM GOALS

The long-range goal of this proposal is to improve our understanding of surface currents and fronts in the northeast South China Sea and their influence on acoustic propagation across the shelfbreak in this low-latitude setting. We propose to use satellite measurements of sea surface temperature, color, height and winds to document and describe the regional surface fronts and mesoscale eddy features and collaborate with other ASIAEX investigators to reach this goal.

OBJECTIVES

Relatively little is known about the general circulation and fronts in the northeast South China Sea. Past work suggests a northeastward current over the outer shelf (the South China Sea Warm Current) and a southwestward current over the slope containing Kuroshio water from the Luzon Strait, however, there exist few in-situ direct current measurements to support this schematic. AVHRR imagery shows that the Kuroshio can bifurcate in the Luzon Strait, with some of its transport entering the South China Sea west of Taiwan. Recent analysis of shipboard ADCP (G. Gawarkiewicz and S. Ramp, personal communication) suggest that these intermittent intrusions (Shaw, 1989) can form large mesoscale eddies (Chu *et al*., 1997) which may influence flow over the Chinese continental margin directly.

The Asian Seas International Acoustics EXperiment (ASIAEX) was developed to investigate the propagation of low frequency sound across the shelfbreak in this region. As part of this program, two one-month field studies are being conducted, featuring high-resolution SeaSoar/ADCP surveys and moored acoustic and physical oceanographic measurements. One objective of the physical measurements is to observe the current and thermohaline fields near the shelfbreak with sufficient spatial and temporal resolution to help interpret the variability observed in the acoustic data. As part of this latter effort, we propose to use satellite data to describe surface features and their evolution during the two field studies. In addition, we propose to use satellite data collected over a three-year span (which includes the two field studies) to better understand the larger-scale surface variability in the

eastern South China Sea on time scales of days to years, and the relationship between this regional variability and that observed in the two smaller-scale shelfbreak field studies.

APPROACH

We began collecting and processing AVHRR, ocean color, and altimeter data for the eastern South China Sea in January 2000, with one objective being to provide early descriptions of the surface features observed in the area of the pilot study (April-May 2000) to ASIAEX investigators planning the pilot study. The collection of the remote sensing data will continue for two full years (into spring, 2002). Archived data for 1999 will be obtained to complete a 3-year plus data set. This time period encompasses the pilot and main (spring 2001) field studies while allowing annual mean fields to be computed and seasonal and interannual differences to be identified. This will allow the pilot and main field study periods to be placed within the longer-term temporal context. For example, a multi-year mean sea surface height (SSH) field will be computed and used to help isolate mesoscale current features and variability. The locations of fronts and eddies will be analyzed to determine whether the features observed during the two field studies were typical. In 2001-03, final data processing will be completed and scientific analysis and collaborations with other investigators continued and completed.

WORK COMPLETED

The latest available data was monitored on land to assist the shipboard interpretation of SeaSoar data during the pilot cruise. Our initial work focused on acquiring and processing the extensive remote sensing data products in the ASIAEX region. We then worked with other investigators to provide broad-scale context during the pilot study. We have begun the process of analyzing the historical remote sensing data. We have acquired and are currently analyzing altimeter data from the ERS altimeters to enhance the spatial coverage of the TOPEX/Poseidon altimeter.

RESULTS

The surface information derived from the passive radiometers such as sea surface temperature and ocean color did not provide much insight into the temporal evolution of the shelf break front or eddies in the South China Sea. Although there were enough cloud free images of the region, the SSTs were dominated by the annual signal that obscured the fronts and eddies. Images of ocean color showed that chlorophyll was primarily confined to the coastal region south of Hong Kong and west of Taiwan. Higher concentrations of chlorophyll could be seen in the Luzon Strait between the Philippines and Taiwan.

Since the passive radiometers would not provide as much information as we had originally hoped, we then began the analysis of sea surface height data from the TOPEX/Poseidon altimeter. Figure 1 shows the Time/Latitude plot of the sea surface height residuals along track 088, which is the descending track just west of the Luzon Strait. Clearly, the most dominant signal is the annual signal, which is also prevalent in the sea surface temperature. However, an interannual signal can also be seen in this figure. In the summer/fall of 1996, an anomaly can be seen around 19° N that moves north to about 21° N. Again in summer/fall of 1998, a similar anomaly can be seen. However, this anomaly does not become as intense as the anomaly of 1996. Finally, an intense anomaly can be seen in the summer/fall of 1999 at 20° N.

IMPACT / APPLICATIONS

There is considerable debate over the frequency and duration of Kuroshio intrusions into the South China Sea. The long-term ERS and TOPEX/Poseidon data record should enable us to characterize the temporal/spatial behavior and interannual variability of this intrusion and its impact on the general circulation west and south of Taiwan and the shelf break front.

TRANSITIONS

We have provided remote sensing data to the WHOI and Taiwanese SeaSoar groups in the ASIAEX program to provide broad scale interpretation of their *in situ* data collected in the 2000 pilot study.

RELATED PROJECTS

The Asian Seas International Acoustics EXperiment (ASIAEX) was developed to investigate the propagation of low frequency sound across the shelfbreak in this region. The insights provided by the Taiwanese SeaSoar data (G. Gawarkiewicz, personal communication) have been helpful in our analysis of the sea surface temperature and ocean color imagery. We have worked with Gawarkiewicz to provide broad scale analysis to help in the interpretation of the pilot SeaSoar data.

REFERENCES

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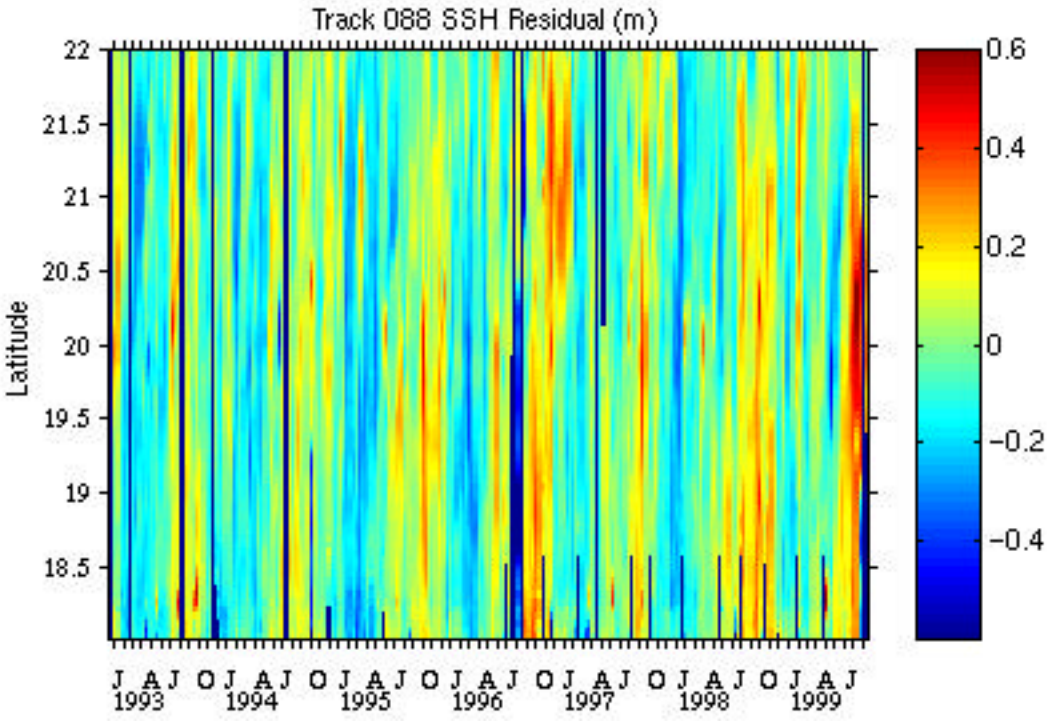

Figure 1 This is the sea surface height residual for TOPEX track 088. This is the descending track that is located just west of Luzon Strait.